

CARRIER

Carrier Info. Rate	1024.0	kbit/s
FEC Code Rate	0.50	
Transmission Bit Rate	2048.0	kbit/s
Modulation Format	BPSK	
Number of Bits/Symbol	1	Bit
Framing Overhead	0	kbit/s
Transmission Symbol Rate	2048	ksym/s
BT Product	1.4	
Spread Factor	2	
Occupied Bandwidth	5734.4	kHz
Noise Equiv. Occupied BW	4096.0	kHz
Allocated Bandwidth	7000.0	kHz

SES AMERICOM AMC-9 83W PARAMETERS*

Uplink Beam	SPOT	
Uplink Frequency Tpr 7-V	14.140	GHz
Downlink Beam	SPOT	
Downlink Frequency Tpr 7-I	11.840	GHz
Transponder Bandwidth	36	MHz
Saturation EIRP (CA)	49.5	dBW
Transponder Output Backoff	3.8	dB
Available EIRP (for alloc. BV	38.6	dBW
Saturation Flux Density (CA)	-97.5	dBW/m^2
Transponder Input Backoff	7.3	dB
Additional Input Backoff	0.0	dB
Operating Flux Density	-111.9	dBW/m^2
Forward Link Pattern Adv	0.0	dB
Receive G/T (CA)	2.0	dB/K
Gain Step	High	

TRANSMIT EARTH STATION - Vertex Model 2.4 SF

Antenna Diameter	2.40	meter
Antenna Area	4.52	meter^2
Antenna Efficiency	63.0	%
Antenna Gain	49.01	dBi
Antenna Pointing Loss	0.5	dB
Elevation Angle (CA)	30.6	degrees

RECEIVE EARTH STATION - Vertex Model 20-18

Dish Antenna Diameter*	0.457	meter
Antenna Area	0.16	meter^2
Antenna Efficiency	57.8	%
Antenna Gain	32.70	dBi
Antenna Pointing Loss	0.5	dB
Wet Radome Loss	1.0	dB
LNA Noise Figure	0.7	dB
LNA Noise Temperature	50.7	K
Clear Sky Noise Temp.	19.9	K
Increase in Sky Temp w/rain	107.4	K
System Noise Temp	112.2	K (no rain)
Receive G/T	12.20	dB/K
Elevation Angle (CA)	30.6	degrees

UPLINK LOSSES

Free Space Path Loss	207.2	dB
Atmospheric Attenuation	0.5	dB
Feed Loss (data sheet)	0.3	dB

DOWNLINK LOSSES

Free Space Path Loss	205.6	dB
Atmospheric Attenuation	0.2	dB
Feed Loss	0.5	dB

RAIN FADE MARGINS for simultaneous fades

Uplink Fade	2.1	dB
Downlink Fade	2.1	dB

FORWARD**LINK BUDGET SUMMARY**

	With Clear Sky	Up-Link Fade	D-Link Fade	Both Fades
UPLINK BUDGET				
Operating Flux Density	-111.9 dBW/m^2	-114.0		-114.0
Total Transmit EIRP	51.8 dBW			
Path, Atm. & Point. Losses	208.2 dB			
Satellite Receive G/T	2.0 dB/K			
Boltzmann's Constant	-228.6 dBW/K/Hz			
Total Uplink C/No	74.2 dB-Hz	72.1		72.1
Number of Active Carriers	1	1		1
Uplink C/No per carrier	74.2 dB-Hz	72.1	74.2	72.1

DOWNLINK BUDGET

Satellite EIRP	38.6 dBW	36.5	38.6	36.5
Path, Atm. & Point. Losses	206.3 dB	206.3	206.3	206.3
Receive Antenna G/T	12.2 dB/K	12.2	8.3	8.3
Boltzmann's Constant	-228.6 dBW/K/Hz	-228.6	-228.6	-228.6
Total Downlink C/No	73.0 dB-Hz	70.9	67.0	64.9
Number of Active Carriers	1	1	1	1
Downlink C/No per carrier	73.0 dB-Hz	70.9	67.0	64.9

OVERALL FORWARD LINK ANALYSIS (Per Carrier)

C/IMo	111.6 dB-Hz	109.5	111.6	109.5
C/Io (CCI)	82.7 dB-Hz	82.7	82.7	82.7
C/Io (ASI-uplink)	100.0 dB-Hz	102.1	100.0	102.1
C/Io (ASI-downlink)	100.0 dB-Hz	100.0	100.0	100.0
C/Io (Terrestrial)	100.0 dB-Hz	100.0	100.0	100.0
C/I (CDMA)	100.0 dB	100.0	100.0	100.0
C/Io (CDMA) noise equiv. B	166.1 dB-Hz	166.1	166.1	166.1
Overall Link C/(No+Io+IMo)	70.3 dB-Hz	68.3	66.2	64.1
Information Rate	60.1 dB-Hz	60.1	60.1	60.1
Available Eb/No	10.2 dB	8.2	6.1	4.0
Required Eb/No	4.0 dB	4.0	4.0	4.0
System Margin	6.2 dB	4.2	2.1	0.0

REQUIRED Eb/No

Required BER	1.0E-06	
Theoretical Eb/No (Turbo)	3.1 dB	
Modem Loss	0.9 dB	
Required Eb/No	4.0 dB	

From MIL-STD-188-EEE NCW Spec.
To bring it up to the next dB level

REQUIRED SSPA SIZE FOR HUB

Required Hub Operating EIRP	51.8 dBW
Feed Losses	0.3 dB
Antenna Gain	49.0 dBi
SSPA Output Backoff	3.0 dB
Reqd SSPA Size	4.06 W

Actual SSPA Max EIRP
Size (W) (dBW)
50.0 65.7

Max EIRP Max Power
Density/4 kHz (Watts)
35.60 46.66

OUTBOUND LINK EIRP DENSITY

SSPA Output Power after backoff	3.1 dBW
Feed Loss	-0.3 dB
Tx Antenna Gain at 2.5° off-axis (per Vert)	19.1 dB
Occupied Bandwidth (noise equiv.)	-66.1 dB-Hz
CCIR Reference Bandwidth (40 kHz)	46.0 dB-Hz
Outbound Link EIRP Density at 2.5° off-a	1.7 dBW/40 kHz
Outbound Link EIRP Density at 2.5° off-a	-8.3 dBW/4 kHz
Outbound Link EIRP Density at Horizon	-35.5 dBW/4 kHz
CCIR EIRP Density Limit at 2.5° off-axis	29.1 dBW/40 kHz
CCIR EIRP Density Limit at 2.5° off-axis	23.1 dBW/40 kHz
FCC EIRP Density Limit at 2.5° off-axis	5.1 dBW/4 kHz
EIRP Density Margin (relative to ITU T28-	21.3 dB
EIRP Density Margin (relative to FCC)	13.3 dB

Operating Pwr
(Watts)
---> 1.90
Operating ERF
(dBdW)
49.65
Uses FCC 29-25log(theta)
Per ITU-R 524-7 for E/S
Per ITU-R 728-1 for VSATs
Per FCC Part 25.209/212

INTERFERENCE TO TERRESTRIAL NETWORKS

Power Flux Density at Earth's surface	-154.2 dBW/m^2/4K
Power Flux Density Limit at Earth's surfac	-135.2 dBW/m^2/4K
Power Flux Density Margin	19.0 dB

per CCIR 358-3

*From Vertex Model 20-18 data sheet

2.4m Fixed Antenna Forward Link Budget: Tx Rate 1024 kbit/s, x2 spreading

Lockheed Martin Integrated Systems & Solutions
700 North Frederick Avenue, Gaithersburg, MD 20879

CARRIER

Carrier Info. Rate	2048.0	kbit/s
FEC Code Rate	0.50	
Transmission Bit Rate	4096.0	kbit/s
Modulation Format	BPSK	
Number of Bits/Symbol	1	Bit
Framing Overhead	0	kbit/s
Transmission Symbol Rate	4096	ksym/s
BT Product	1.4	
Spread Factor	1	
Occupied Bandwidth	5734.4	kHz
Noise Equiv. Occupied BW	4096.0	kHz
Allocated Bandwidth	7000.0	kHz

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Transponder Output Backoff	3.8	dB
Available EIRP (for alloc. BV	38.6	dBW
Saturation Flux Density (CA)	-97.5	dBW/m^2
Transponder Input Backoff	7.3	dB
Additional Input Backoff	0.0	dB
Operating Flux Density	-111.9	dBW/m^2
Forward Link Pattern Adv	0.0	dB
Receive G/T (CA)	2.0	dB/K
Gain Step	High	

TRANSMIT EARTH STATION - Vertex Model 2.4 SF

Antenna Diameter	2.40	meter
Antenna Area	4.52	meter^2
Antenna Efficiency	63.0	%
Antenna Gain	49.01	dBi
Antenna Pointing Loss	0.2	dB
Elevation Angle (CA)	30.6	degrees

RECEIVE EARTH STATION - Vertex Model 20-18

Dish Antenna Diameter*	0.457	meter
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Antenna Efficiency	57.8	%
Antenna Gain	32.70	dBi
Antenna Pointing Loss	0.5	dB
Wet Radome Loss	1.0	dB
LNA Noise Figure	0.7	dB
LNA Noise Temperature	50.7	K
Clear Sky Noise Temp.	19.9	K
Increase in Sky Temp w/rain	81.8	K
System Noise Temp	112.2	K (no rain)
Receive G/T	12.20	dB/K
Elevation Angle (CA)	30.6	degrees

UPLINK LOSSES

Free Space Path Loss	207.2	dB
Atmospheric Attenuation	0.5	dB
Feed Loss (data sheet)	0.3	dB

DOWNLINK LOSSES

Free Space Path Loss	205.6	dB
Atmospheric Attenuation	0.2	dB
Feed Loss	0.5	dB

RAIN FADE MARGINS for simultaneous fades

Uplink Fade	0.0	dB
Downlink Fade	1.5	dB

FORWARD**LINK BUDGET SUMMARY**

	With Clear Sky	Up-Link Fade	D-Link Fade	Both Fades
UPLINK BUDGET				
Operating Flux Density	-111.9 dBW/m^2	-111.9		-111.9
Total Transmit EIRP	51.5	dBW		
Path, Atm. & Point. Losses	207.9	dB		
Satellite Receive G/T	2.0	dB/K		
Boltzmann's Constant	-228.6	dBW/K/Hz		
Total Uplink C/No	74.2	dB-Hz	74.2	74.2
Number of Active Carriers	1		1	1
Uplink C/No per carrier	74.2	dB-Hz	74.2	74.2

DOWNLINK BUDGET

Satellite EIRP	38.6	dBW	38.6	38.6	38.6
Path, Atm. & Point. Losses	206.3	dB	206.3	206.3	206.3
Receive Antenna G/T	12.2	dB/K	12.2	8.8	8.8
Boltzmann's Constant	-228.6	dBW/K/Hz	-228.6	-228.6	-228.6
Total Downlink C/No	73.0	dB-Hz	73.0	68.2	68.2
Number of Active Carriers	1		1	1	1
Downlink C/No per carrier	73.0	dB-Hz	73.0	68.2	68.2

OVERALL FORWARD LINK ANALYSIS (Per Carrier)

C/IMo	111.6	dB-Hz	111.6	111.6	111.6
C/Io (CCI)	82.7	dB-Hz	82.7	82.7	82.7
C/Io (ASI-uplink)	100.0	dB-Hz	100.0	100.0	100.0
C/Io (ASI-downlink)	100.0	dB-Hz	100.0	100.0	100.0
C/Io (Terrestrial)	100.0	dB-Hz	100.0	100.0	100.0
C/I (CDMA)	100.0	dB	100.0	100.0	100.0
C/Io (CDMA) noise equiv. B	166.1	dB-Hz	166.1	166.1	166.1
Overall Link C/(No+Io+IMo)	70.3	dB-Hz	70.3	67.1	67.1
Information Rate	63.1	dB-Hz	63.1	63.1	63.1
Available Eb/No	7.2	dB	7.2	4.0	4.0
Required Eb/No	4.0	dB	4.0	4.0	4.0
System Margin	3.2	dB	3.2	0.0	0.0

REQUIRED Eb/No

Required BER	1.0E-06	
Theoretical Eb/No (Turbo)	3.1	dB
Modem Loss	0.9	dB
Required Eb/No	4.0	dB

From MIL-STD-188-EEE NCW Specification
To bring it up to the next dB level

REQUIRED HPA SIZE FOR HUB

Required Hub Operating EIRP	51.5	dBW	Actual HPA	Max EIRP
Feed Losses	0.3	dB	Size (W)	(dBW)
Antenna Gain	49.0	dBi	50.0	65.7
HPA Output Backoff	3.0	dB		
Reqd HPA Size	3.79	W	Max EIRP	Max Power
			Density/4 kHz	(Watts)
			35.60	46.66

OUTBOUND LINK EIRP DENSITY

HPA Output Power after backoff	2.8	dBW		
Feed Loss	-0.3	dB		
Tx Antenna Gain at 2.5° off-axis (per Vert)	19.1	dB		Operating Pwr
Occupied Bandwidth (noise equiv.)	-66.1	dB-Hz		(Watts)
CCIR Reference Bandwidth (40 kHz)	46.0	dB-Hz		1.77
Outbound Link EIRP Density at 2.5° off-axis	1.4	dBW/40 kHz		Operating ERF
Outbound Link EIRP Density at 2.5° off-axis	-8.6	dBW/4 kHz		(dBW)
Outbound Link EIRP Density at Horizon	-35.8	dBW/4 kHz		49.35
CCIR EIRP Density Limit at 2.5° off-axis	29.1	dBW/40 kHz		Uses FCC 29-25log(theta)
CCIR EIRP Density Limit at 2.5° off-axis	23.1	dBW/40 kHz		Per ITU-R 524-7 for E/S
FCC EIRP Density Limit at 2.5° off-axis	5.1	dBW/4 kHz		Per ITU-R 728-1 for VSATs
EIRP Density Margin (relative to ITU 728-	21.6	dB		Per FCC Part 25.209/212
EIRP Density Margin (relative to FCC)	13.6	dB		

INTERFERENCE TO TERRESTRIAL NETWORKS

Power Flux Density at Earth's surface	-154.2	dBW/m^2/4K	per CCIR 358-3
Power Flux Density Limit at Earth's surface	-135.2	dBW/m^2/4K	
Power Flux Density Margin	19.0	dB	

*From Vertex Model 20-18 data sheet

2.4m Fixed Antenna Forward Link Budget: Tx Rate 2048 kbit/s, no spreading